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OUTSIDE PRIMA PORTA, AND WITHIN – INSTANCES OF BIODIVERSITY

The Mediterranean basin is recognized as a biodiversity 'hotspot.' Hotspot, implies high numbers of endemic species and their unique, associated behaviors. The forces underlying this high biodiversity are climatic, geographic and geological (including volcanism) in general, with more specific ecological to physical factors operating on the local scale. Biodiversity is a contraction of 'biological diversity:' a concept that became accepted in the mid-1980s.[1] Thus, its study is recent - from the biodiversity standpoint, there is much to be described and understood.

Biodiversity is not static; two of the important dynamic forces of the last one hundred thousand to two hundred thousand years of earth history - are climate and human action. This longish time period encompasses major global changes in earth's climate: the relatively warm Interglacials from about one hundred and thirty thousand to seventy-four thousand ago, and from ten thousand to present; and the recent cold Glacial maximum at twenty one thousand years ago. The Italian peninsula was not covered by continental glaciers during this maximum (the closest ice boundary was in northern France) although alpine glaciers were significantly larger. The peninsula still experienced profoundly shifting climatic regimes over centuries to millennia. Is biodiversity, found in ecological niches including those of the Italian peninsula today, a result of such major climate changes?

While present-day species, their associations, and their genomes may be mapped today, recreating past species types and distributions must be based upon fossils studies *in proprio*, including archeology-based research. At the end of the 1990s, the technology to analyze genomes, of fossils, commences. Most of this newer genomic analysis focuses on human remains, followed by important domesticates (dogs, bovines, cereal grasses, for example). With radionuclides used to date the fossils (^{14}C, radiocarbon is very popular), and genomic analysis to provide species identification, a very partial but exciting picture of biodiversity, going back in time, may be recreated. How did humans, increasing in number and settlements over today's Western Europe, during the last 10.000 years, influence the region's biodiversity?

Research, to understand species types and their distributions back into time, is driven by these two major questions. The questions are posed for a Western European region, Prima Porta, but the endeavor is global.

Is a species occurrence natural? In other words, is human influence absent or negligible?

The *potential natural* vegetation around Rome today is mixed evergreen and deciduous oak species, very generally.[2] The managed agricultural lands are now at 57 percent, and 25 percent remains forest (much managed).[3] These natural tree species replaced the steppe and *Picea* vegetation, representative of glacial climate. Further from Rome, some mesophilous and thermophilous trees did grow during the glacial period.[4] The vegetation changes driven by climate forcings, were most rapid from about fourteen thousand to nine thousand years ago during the transition into the warmer, moister Holocene epoch (demarked ten thousand years ago). Likely the meso- and thermophilous tree types expanded their ranges from glacial refugia (imagine topographic niches with relative warm, moist microclimates) mysteriously located throughout the whole Mediterranean basin. Plant migration (their seeds) came even from outside the peninsula. The physical mode of this migration - wind, birds, other mammals, water - can be imagined. The evidence of natural vegetation, prior to historical records, derives primarily from plant pollen and macroremains - seeds, leaves, and charcoal, in sediments. Identification of these fossils is not as precise as actual visual identification - the taxa are identified to genus (not species) level usually.

Studies of particular interest to biodiversity affected by human action, are based on genomes from actual plants and their macroremains. Domesticated olive and grape were not part of the natural vegetation of this region in the past; their expansion into the Italian peninsula indicates cultural support from modern humans, evidence that humans began altering the region's biodiversity. These plants do not leave abundant traces. Relatively more fossils have been found of wheat's early domesticates (*Triticum* and *Aegilops* species). All these taxa are the focus of many recent paleoecological studies, for the Southern Europe Mediterranean region, due to their importance as food crops.

The term, expansion, is deliberately vague: olive and grape can be wild, or domesticated; the wild and domesticated types may be assigned the same species name, or not; the domesticate can derive from selective breeding of a local wild taxa or an introduced taxon, or some combination thereof. In summary, the breeding of new plant species was deliberate and/or casual, and participants (both plants and humans) were both wild/local and invasive/foreign. Assigning an origin, and known 'breeder's pedigree,' to these important plants, is difficult. Here is one summary of the likely origins of domesticated olive, *Olea europaea* ssp. *europaea*, based on DNA analyses of both wild and domesticated olive trees:

> Regional hotspots of plastid diversity, species distribution modelling and macro-fossils support the existence of three long-term refugia; namely the Near East (including Cyprus), the Aegean area and the Strait of Gibraltar. These ancestral wild gene pools have provided the essential foundations for cultivated olive breeding. [Our analysis] indicates the cradle of first domestication in the northern Levant followed by dispersals across the Mediterranean basin in parallel with the expansion of civilizations and human exchanges in this part of the world.[5]

Phylogeographical analyses exists also for *Laurus nobilis*,[6] and then there are numerous volumes and papers devoted to the wheat and barley cereal grasses.

Such botanical-based research, addressing plant species distributions during Roman times and earlier, rarely addresses the plants in the frescos of Livia's villa at Prima Porta, Rome.[7] Therefore, to put a biodiversity framework onto the 24 species shown - is to imagine a mosaic, with very few pieces available. In order to puzzle-out the dynamic forces (e.g., climate, human interference including domestication and migrations) which may have influenced the plant assemblages (or associations) on the frescos, each species could be assigned to a category: potential natural

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vegetation of Rome ca 40-30 BCE; taxa not local but still endemic to the peninsula; taxa relevant to domesticated or cultivated crops, and; taxa derived from ancestors with no known local examples (call them allochthonous or foreign). Applying these categories raises one's curiosity. Three fruit trees are represented, all allochthonous in origin: *Cydonia oblonga* (quince); *Punica granatum* (pomegranate), and *Phoenix dactylifera* (date palm). *Arbutus unedo* (*corbezzolo*) and *Myrtus communis* (*mirto*) produce edible fruits, although not in high volumes, and they are autochthonous to the peninsula. Can we hypothesize any meaning for these associations - that is the research puzzle!

Myers (p. 40) writes, "Livia's commission in this new Second Style of painting (ca 40-30 BCE) visually celebrates garden and plant knowledge and seems to confirm her participation in contemporary elite (male) competition for fame in plant breeding and collecting." Were the painted fruit trees the subjects of plant breeding efforts? This is fun speculation.

Earth's biodiversity, now, is experiencing erosion of genomic diversity and species extinction; and humans are greatly responsible for these losses. However, a few taxa that are adaptable to domestication, have actually shown the opposite trend.[8] Crop domestication and breeding of new taxa (cultivars, landraces, varieties, etc.), has actually created new species.[9] *Vitis vinifera* L. subsp. *sativa* (domesticated grapevine) is related to, but still a different sub-species from *Vitis vinifera subsp. sylvestris* (syn. *Vitis sylvestris* C.C. Gmel, wild grapevine).[10] Common bread wheat, *Triticum aestivum*, grown over much of western Europe today (and other continents), is a different species from its mix of ancestors located in the Karacadağ region (Turkey), and the upper Jordan valley.[11] The domestication process is linked to the selection of traits, as humans decide whose seed to save and carry, and whose to ignore - it is a global phenomenon of the last ten thousand plus years.

Modern commodity-based agriculture, whose metrics are production and yield for the global markets, favors monocultures with short life spans. The result, widely acknowledged, is reduction in biodiversity. This biodiversity loss is evident in wildlife, pollinators, insect pests, their natural enemies, soil invertebrates, and microorganisms.[12] However, some of the first studies addressing biodiversity concepts, also did recognize the importance of so-called traditional agroecosystems, in supporting high biodiversity. Traditional agroecosystems, pre-industrial age forms, are fast disappearing globally. Innovative research methods are applied to identify the remaining systems, and even to parse out traces of past systems. For Italy and the Lazio region, examples are in Porfiri et al. (2008)[13] and Frattaroli et al, (2014).[14] Very far away, on the Pacific Ocean coast of North America, comes one of the most exciting discoveries about past-high biodiversity agroecosystems: the deliberate cultivation of 'forest gardens' by indigenous gardeners. These managed agroecosystems were so strange to our standard models of domestication and cultivation, that their traces were overlooked. Actual plant surveys reveal that "isolated patches of fruit trees and berry bushes in the region's hemlock and cedar forests were *deliberately* planted by Indigenous peoples in and around their settlements more than 150 years ago" of now British Columbia.[15] These studies are for the past few centuries at best, so we can speculate for earlier times.

The frescos of Prima Porta also show fruit trees (quince, pomegranate) with berry bushes (*corbezzolo* and *mirto*) amidst conifers, other local trees, and flowers. With these very few puzzle pieces, one can optimistically imagine Livia and her gardeners, experimenting with associations of exotics along with local wild plants, to create forest gardens. Doing her part, to support biodiversity.

Notes

[1] See: Edward O. Wilson, *The Diversity of Life* (New York: W.W. Norton, 1999).

[2] Carlo Blasi et al., *The Ecoregions of Italy. A thematic contribution to the National Biodiversity Strategy* (Rome: Ministry of the Environment, Land and Sea Protection - CIRBFEP - University of Salerno, 2010), 11-12, Retrieved from www.mite.gov.it/sites/default/files/archivio/biblioteca/protezione_natura/ecoregioni_italia_eng.pdf

[3] European Commission, "Factsheet on 2014-2020 Rural Development Programme for Lazio" (Ec.europa.eu, 11/2021), 2, Accessed August 7, 2021 from https://ec.europa.eu/info/sites/default/files/food-farming-fisheries/key_policies/documents/rdp-factsheet-italy-lazio_en.pdf.

[4] Maria Follieri et al., "Palynostratigraphy of the Last Glacial Period in the Volcanic Region of Central Italy," *Quaternary International* 47-48 (March 1998), 3-20, https://doi.org/10.1016/S1040-6182(97)00065-7.

[5] Guillaume Besnard et al., "The complex history of the olive tree: from Late Quaternary diversification of Mediterranean lineages to primary domestication in the northern Levant," *Proceedings of the Royal Society B: Biological Sciences*, 7 April 2013, https://doi.org/10.1098/rspb.2012.2833.

[6] Francisco Rodríguez-Sánchez, et al., "Late Neogene history of the laurel tree (Laurus L., Lauraceae) based on phylogeographical analyses of Mediterranean and Macaronesian populations," *Journal of Biogeography* 36, no. 7 (July 2009): 1270-1281, https://doi.org/10.1111/j.1365-2699.2009.02091.x.

[7] Giulia Caneva and Lorenza Bohuny, "Botanical Analysis on the Livia's Villa Painted Flora (Prima Porta, Rome)," *Science and Technology in Cultural Heritage* 4, no. 2 (2003): 149-155.

[8] Jared Diamond, *Guns, Germs, and Steel: The Fates of Human Societies* (New York: WW Norton & Co, 1997).

[9] The definition of Species, varies, and should be evaluated as one writes of 'new species.' But for this paper, the common definition is used - sexual reproduction results in fertile offspring. Animal domestication has also created new species.

[10] Claudio D'Onofrio, "Introgression Among Cultivated and Wild Grapevine in Tuscany," *Frontiers in Plant Science 11, no. 2 (February 2020): Article 202,* https://doi.org/10.3389/fpls.2020.00202.

[11] Hatice Bilgic et al., "Ancient DNA from 8400 Year-Old Çatalhöyük Wheat: Implications for the Origin of Neolithic Agriculture," *PLoS ONE* 11, no. 3 (2016): e0151974, https://doi.org/10.1371/journal.pone.0151974.

[12] Biodiversity loss: 1. Power and Flecker give a late twentyth century perspective, written for general science readers; 2. while Johnson et al., (2017) publish a complete research-level review; 3. then the 1992 UN Convention on Biological Diversity (CBD) is the major intergovernmental instrument, while; 4. the 2021 UK report "The Economics of Biodiversity: The Dasgupta Review" marked the overall acceptance of Biodiversity's critical importance to human welfare. Full reference citations are in the Bibliography.

[13] Oriana Porfiri, Maria Teresa Costanza and Valeria Negri, "10. Landrace Inventories in Italy and the Lazio Region Case Study," in *European landraces: on farm conservation, management and use*, edited by Veteläinen, Merja, Valeria Negri and Nigel Maxted, *Biodiversity Technical Bulletin* no. 15 (Rome: Biodiversity International, 2009), 117-123.

[14] Anna Rita Frattaroli et al., "The disappearance of traditional agricultural landscapes in the Mediterranean basin. The case of almond orchards in Central Italy," *Plant Sociology* 51, no. 2 (December 2014): 3-15, https://doi.org/10.7338/pls2014512/01.

[15] C. G. Armstrong et al., "Historical indigenous land-use explains plant functional trait diversity," *Ecology and Society* 26, no. 2 (2021):6, https://doi.org/10.5751/ES-12322-260206 is the research article. Andrew Curry writes a summary, "Pacific Northwest's 'forest gardens' were deliberately planted by Indigenous people," *Science*, published online April 22, 2021, https://doi.org/10.1126/science.abj1396.

Bibliography

Armstrong, Chelsey Geralda, Jesse E. D. Miller, Alex C. McAlvay, Patrick Morgan Ritchie, and Dana Lepofsky. „Historical indigenous land-use explains plant functional trait diversity." *Ecology and Society* 26, no. 2 (2021): 6. https://doi.org/10.5751/ES-12322-260206.

Besnard G., B. Khadari, M. Navascués, M. Fernández-Mazuecos, A. El Bakkali, N. Arrigo, D. Baali-Cherif, V. Brunini-Bronzini de Caraffa, S. Santoni, P. Vargas, and V. Savolainen. "The complex history of the olive tree: from Late Quaternary diversification of Mediterranean lineages to primary domestication in the northern Levant." *Proc R Soc B Biological Sciences* 280: 20122833 (2013). http://dx.doi.org/10.1098/rspb.2012.2833.

Bilgic, Hatice, Erdogan E. Hakki, Anamika Pandey, Mohd. Kamran Khan, Mahinur S. Akkaya. "Ancient DNA from 8400 Year-Old Çatalhöyük Wheat: Implications for the Origin of Neolithic Agriculture." *PLoS ONE* 11, no. 3 (2016): e0151974. doi:10.1371/journal.pone.0151974.

Blasi, Carlo, Giulia Capotorti, Daniela Smiraglia, Domenico Guida, Laura Zavattero, Barbara Mollo, Raffaella Frondoni, Riccardo Copiz. *The Ecoregions of Italy. A thematic contribution to the National Biodiversity Strategy*. Rome: Ministry of the Environment, Land and Sea Protection – CIRBFEP – University of Salerno. www.mite.gov.it/sites/default/files/archivio/biblioteca/protezione_natura/ecoregioni_italia_eng.pdf

CBD (1992) The United Nations Convention on Biological Diversity. Reprinted in International Legal Materials 31 (5 June 1992): 818. (Entered into force 29 December 1993).

Caneva, Giulia and Lorenza Bohuny. "Botanical Analysis on the Livia's Villa Painted Flora (Prima Porta, Rome)." *Science and Technology in Cultural Heritage* 4, no. 2 (2003): 149-155.

Curry, Andrew. "Pacific Northwest's 'forest gardens' were deliberately planted by Indigenous people." *Science*. Published online April 22, 2021. https://doi.org/ doi.org/10.1126/science.abj1396.

D'Onofrio, Claudio. "Introgression Among Cultivated and Wild Grapevine in Tuscany." *Frontiers in Plant Science* 11, no. 2 (February 2020): Article 202, https://doi.org/10.3389/fpls.2020.00202.

Dasgupta, Partha. *The economics of biodiversity: the Dasgupta review*. Hm Treasury, 2021.

Diamond, Jared. *Guns, Germs, and Steel: The Fates of Human Societies*. New York: WW Norton & Co, 1997.

Ec.europa.eu, 11/2021, https://ec.europa.eu/info/sites/default/files/food-farming-fisheries/key_policies/documents/rdp-factsheet-italy-lazio_en.pdf.

Follieri, Maria, Marco Giardini, Donatella Magri and Laura Sadori. "Palynostratigraphy of the Last Glacial Period in the Volcanic Region of Central Italy." *Quaternary International* 47-48 (March 1998): 3-20. https://doi.org/10.1016/S1040-6182(97)00065-7.

Frattaroli, A. R., S. Ciabò, G. Pirone, D. M. Spera, A. Marucci, and B. Romano. „The disappearance of traditional agricultural landscapes in the Mediterranean basin. The case of almond orchards in Central Italy." *Plant Sociology* 51, no. 2 (2014): 3-15. https://doi.org/10.7338/pls2014512/01.

Johnson, Christopher N., Andrew Balmford, Barry W. Brook, Jessie C. Buettel, Mauro Galetti, Lei Guangchun, and Janet M. Wilmshurst. „Biodiversity losses and conservation responses in the Anthropocene." *Science* 356, no. 6335 (2017): 270-275. doi: 10.1126/science.aam9317

Porfiri, Oriana, Maria Teresa Costanza, and Valeria Negri. "10. Landrace Inventories in Italy and the Lazio Region Case Study." In *European landraces: on-farm conservation, management and use*, edited by Veteläinen, Merja, Valeria Negri and Nigel Maxted, 117–123. *Biodiversity Technical Bulletin* no. 15. Rome: Biodiversity International, 2009.

Power, Alison G. and Alexander S. Flecker. "Agroecosystems and Biodiversity." Smithsonian's National Zoo & Conservation Biology Institute, Smithsonian Migratory Bird Center. *nationalzoo.si.edu*. Accessed May 10, 2022. https://nationalzoo.si.edu/scbi/migratorybirds/research/cacao/power.cfm.

Rodríguez-Sánchez, F., B. Guzmán, A. Valido, P. Vargas, and J. Arroyo. "Late Neogene history of the laurel tree (*Laurus* L., Lauraceae) based on phylogeographical analyses of Mediterranean and Macaronesian populations." *Journal of Biogeography* 36, no.7 (2009): 1270-1281. https://doi.org/10.1111/j.1365-2699.2009.02091.x.

Wilson, Edward O. *The Diversity of Life*. New York: W.W. Norton, 1999.